

- [54] SHEET COUNTING MACHINE
- [75] Inventors: **Takashi Kondó; Motoaki Fukunaga; Hisashi Kitakami**, all of Himeji, Japan
- [73] Assignee: **Glory Kogyo Kabushiki Kaisha**, Japan
- [22] Filed: **Feb. 7, 1975**
- [21] Appl. No.: **548,080**
- [52] U.S. Cl. **235/92 SB; 235/92 CT; 235/92 CA; 235/92 R**
- [51] Int. Cl.² **H03K 21/36**
- [58] Field of Search **235/92 SB, 92 CT, 92 CA, 235/92 PE, 92 MS, 92, 98 R**

3,710,936 1/1973 Mizunuma..... 235/92 SB
 3,795,796 3/1974 Shigemori et al. 235/92 SB

Primary Examiner—Gareth D. Shaw
Assistant Examiner—John P. Vandenburg
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A sheet counting machine has a sheet counting mechanism which is controlled through a coincidence detecting circuit operating to compare a number of sheets counted with a predetermined number of sheets. The coincidence detecting circuit is provided with a mode changing switch and an inverter connected thereto in the output path to relatively reverse a logical level of an output of the coincidence detecting circuit stop mode. The logical level thus relatively reversed is utilized for controlling the operation of the mechanism through switching elements and relay elements.

1 Claim, 9 Drawing Figures

- [56] **References Cited**
- UNITED STATES PATENTS**
- 3,588,472 6/1971 Glaster et al. 235/92 SB
- 3,652,833 3/1972 Shigemori et al. 235/92 SB
- 3,682,544 8/1972 Glaser 235/92 SB

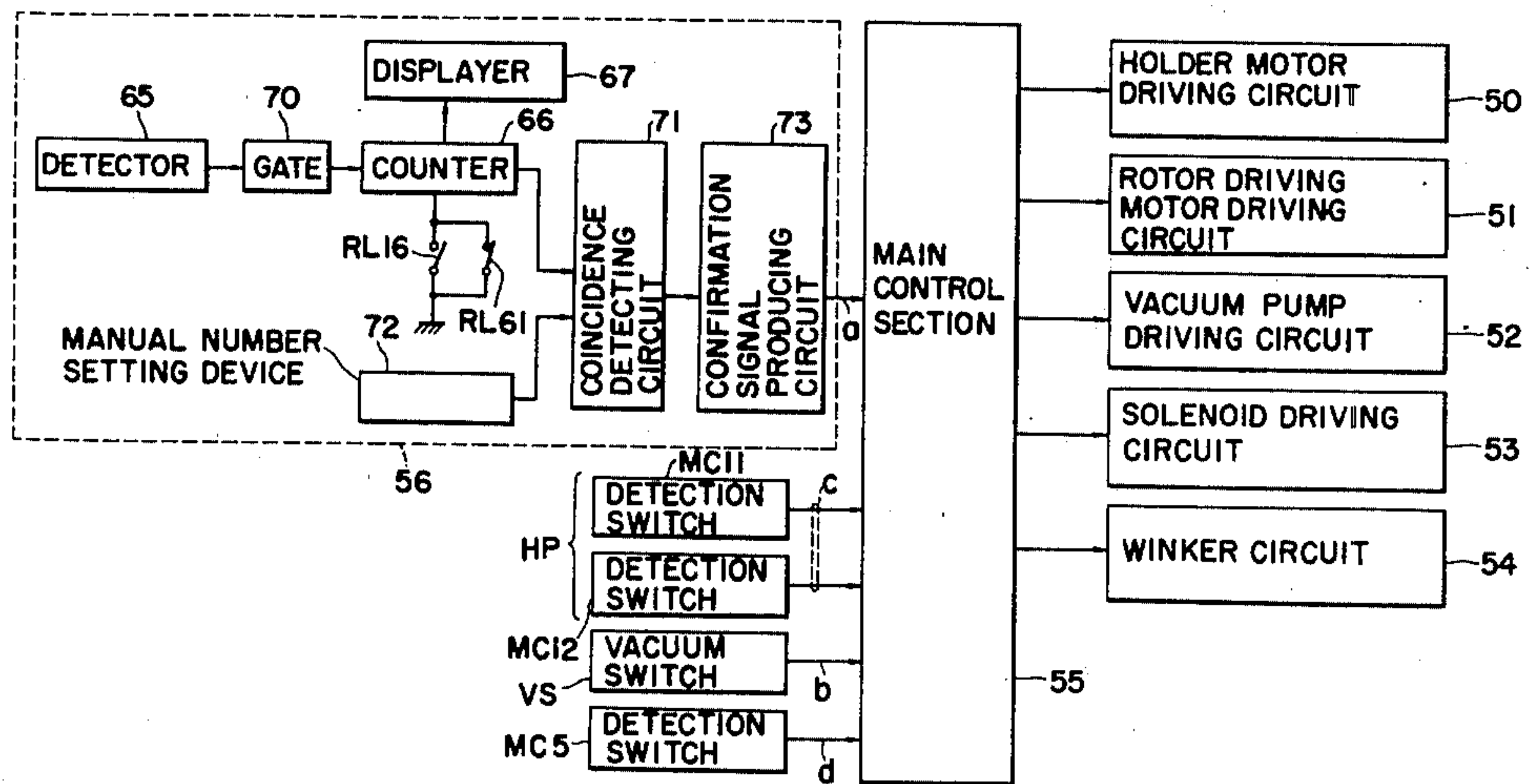


FIG. 1

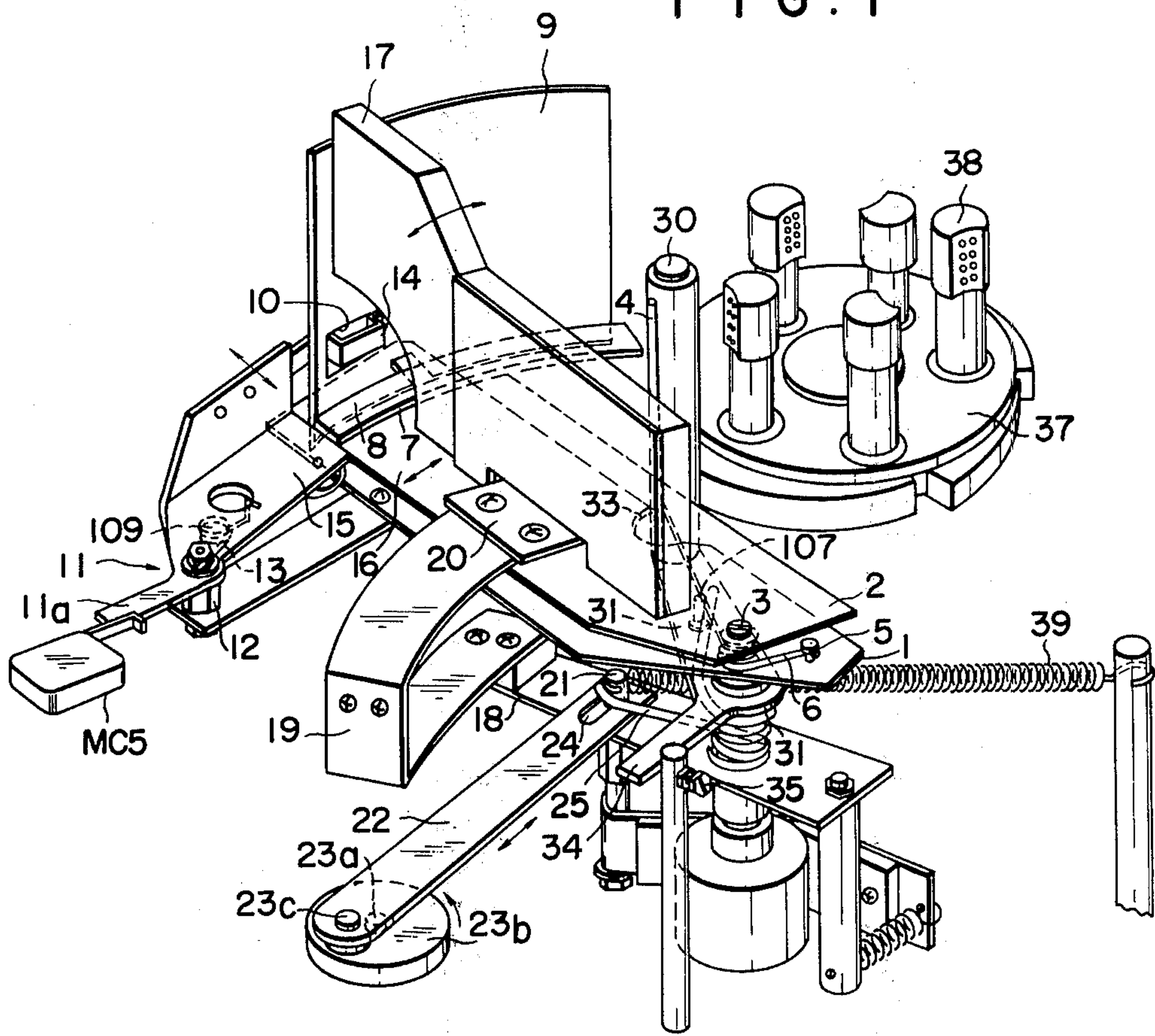


FIG. 2

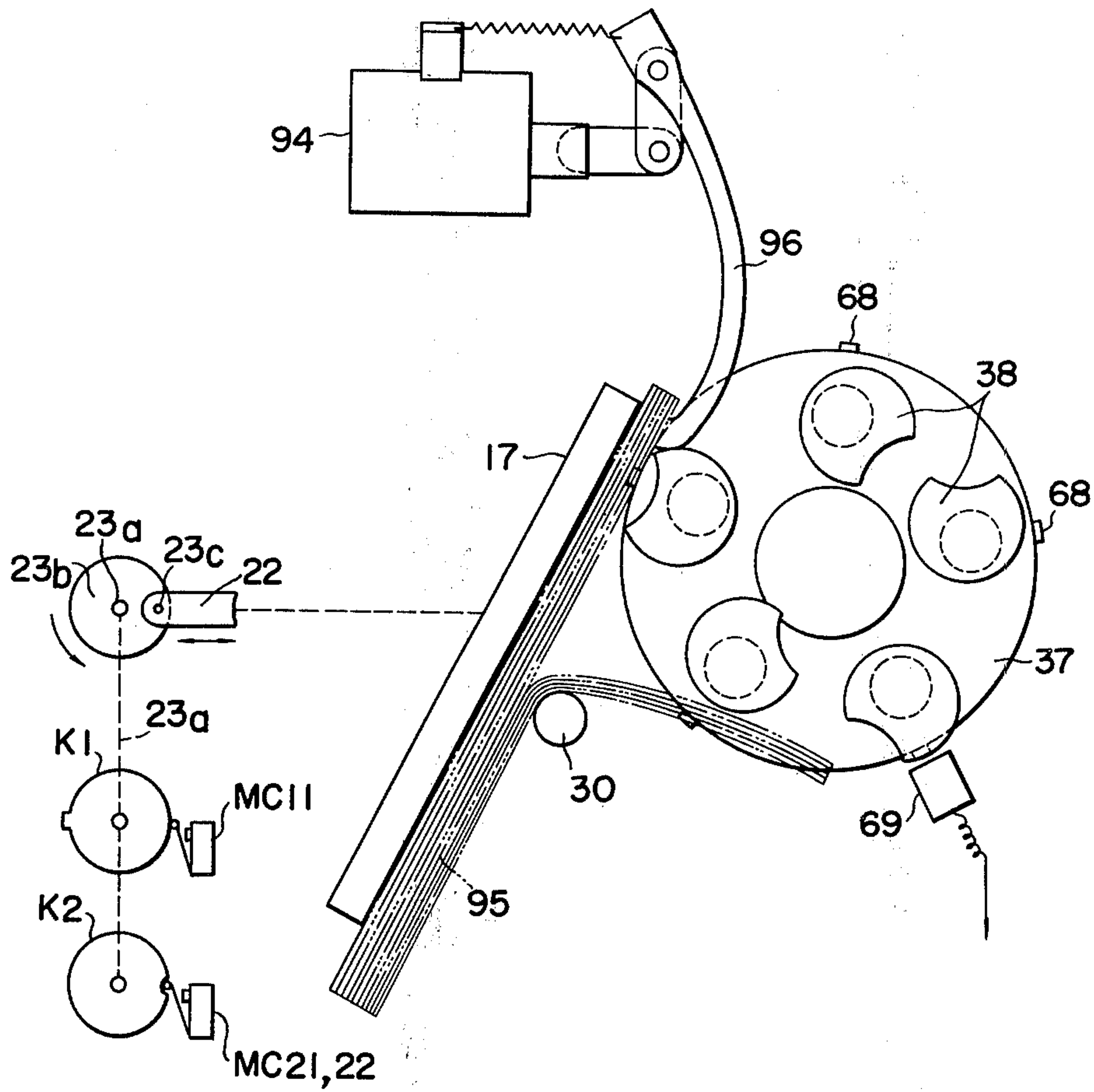


FIG. 3

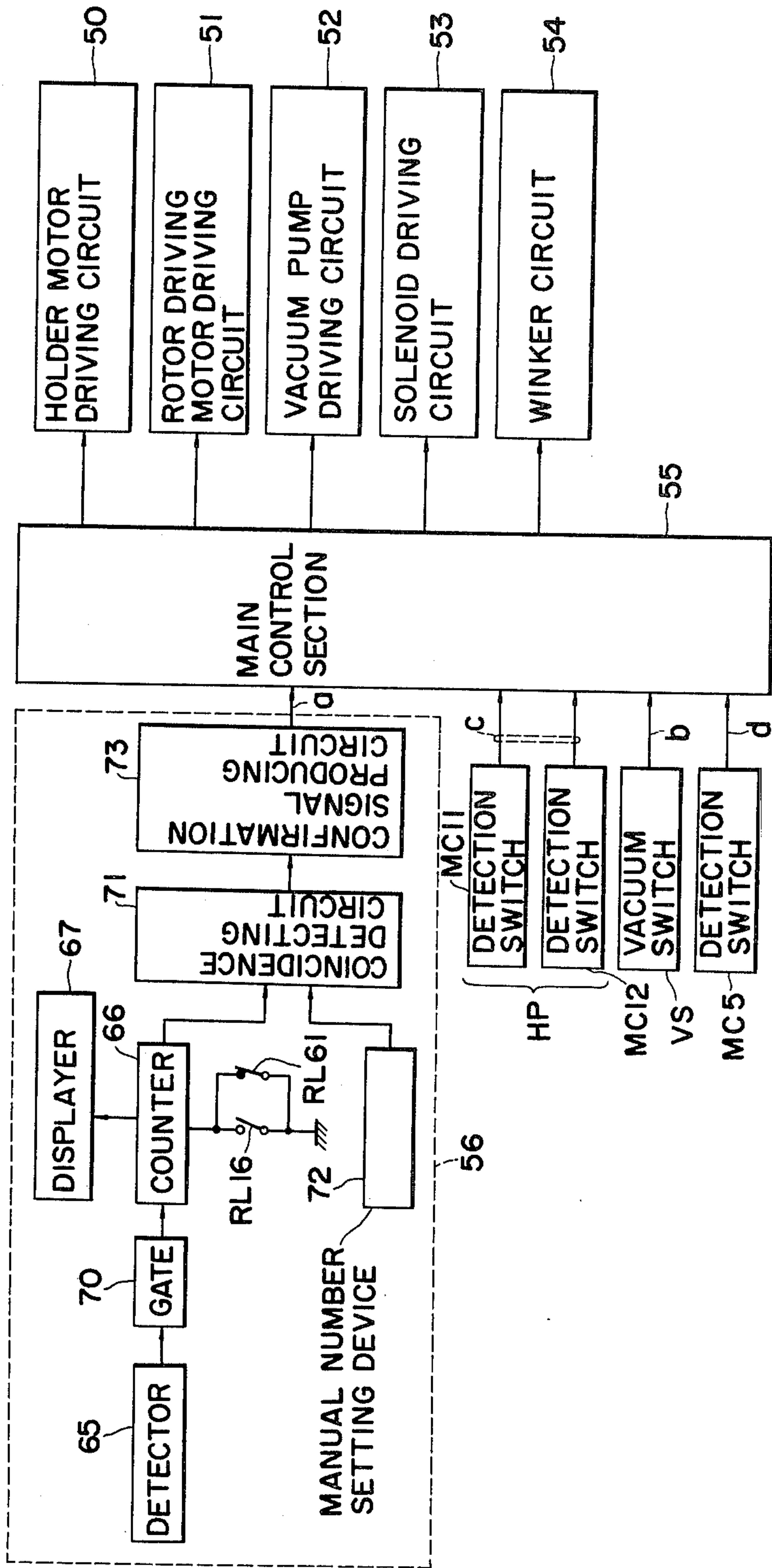


FIG. 4

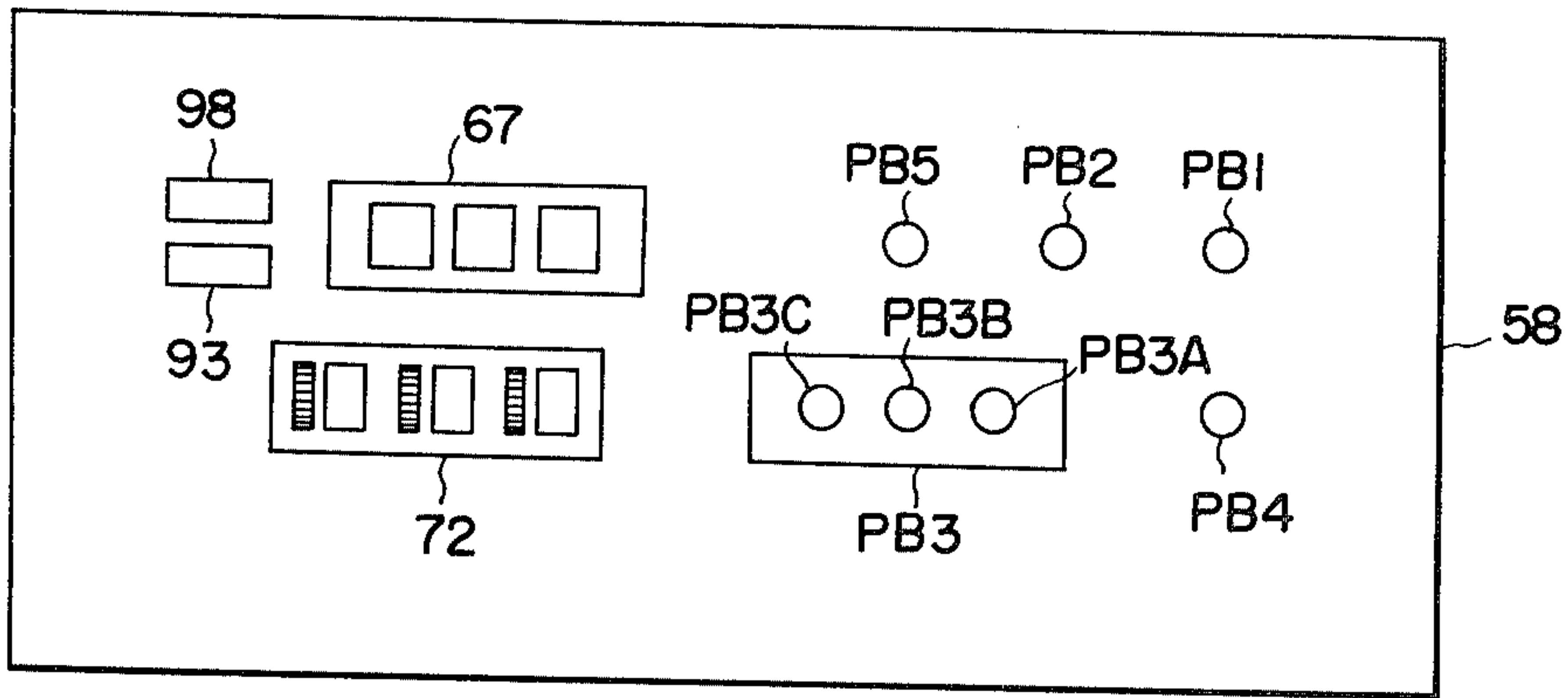


FIG. 6

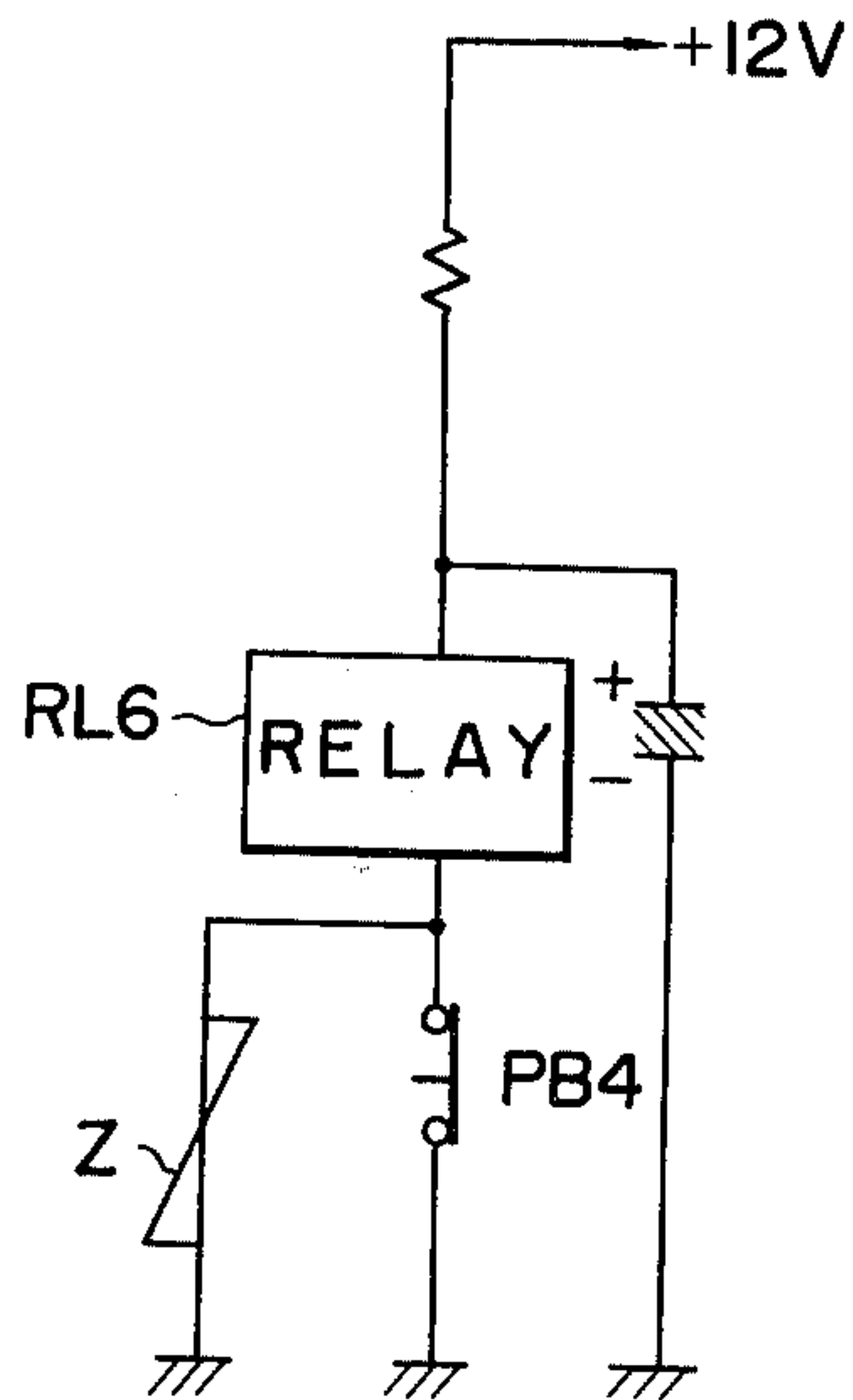


FIG. 8

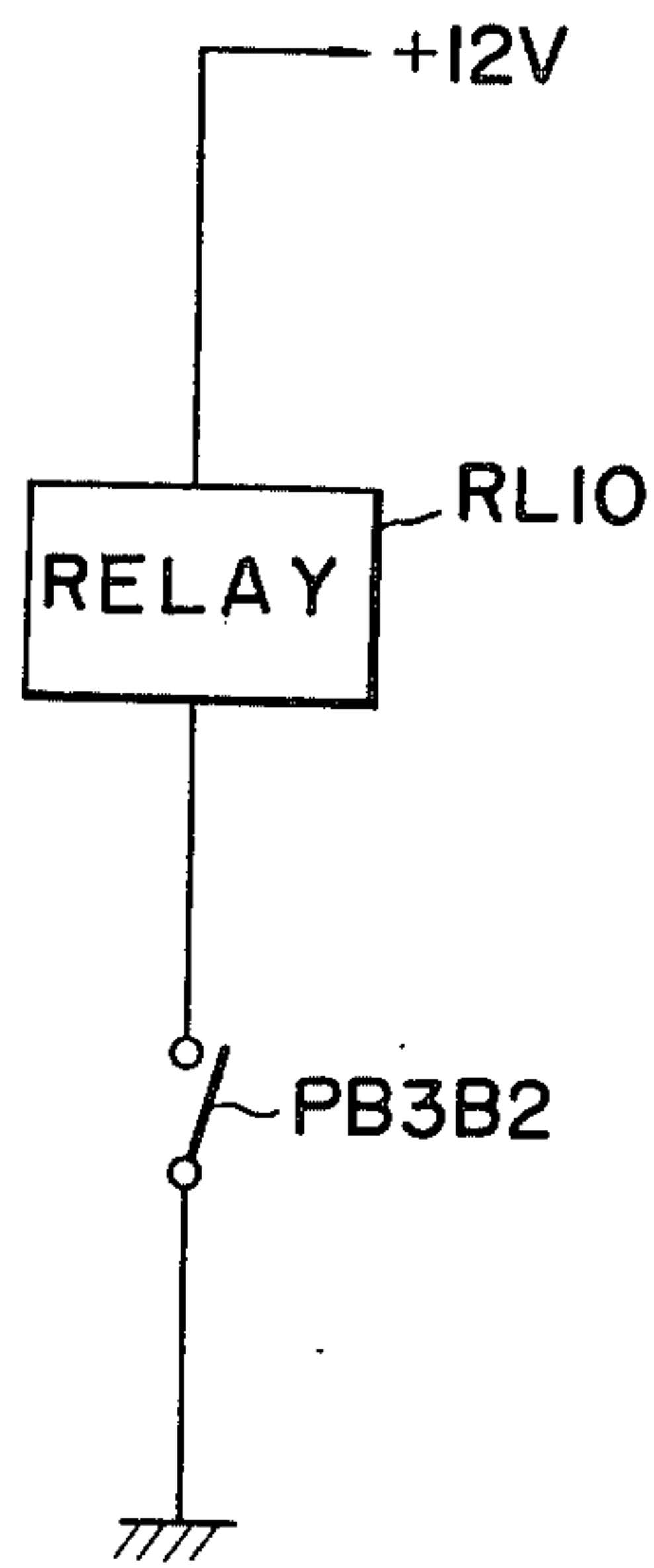


FIG. 5

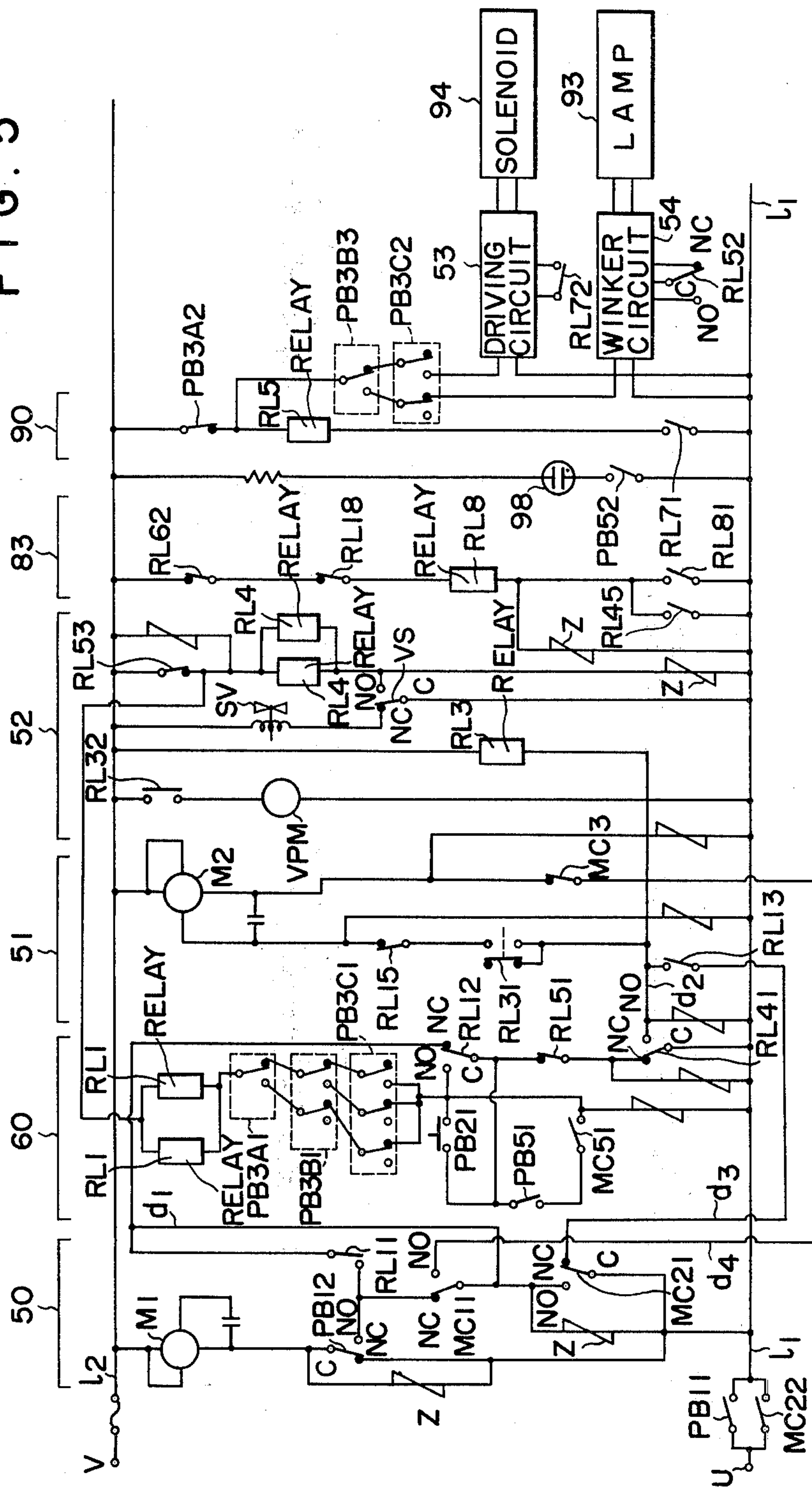
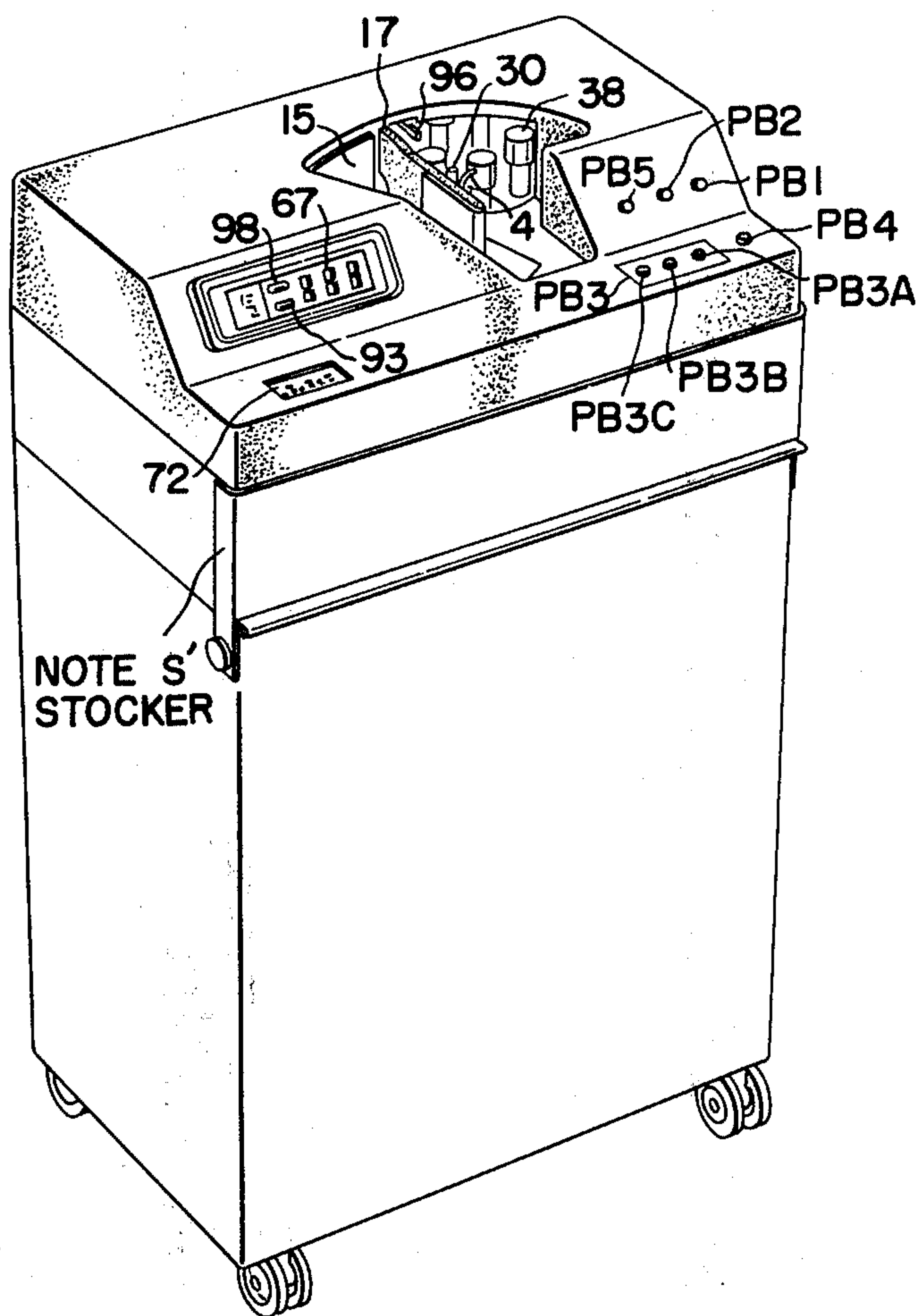


FIG. 9



SHEET COUNTING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to sheet counting machines operating to count a number of sheets such as bank notes and cards.

There are two types of sheet counting machines known in the art. One is operated in a sheet counting mode in which a number of sheets to be counted in one sheet counting operation is predetermined and the sheet counting operation is suspended when the number of sheets counted reaches the predetermined number of sheets (hereinafter referred to as "an automatic stop mode"). The other is operated in a sheet counting mode in which all of the sheets inserted are counted, and upon completion of the sheet counting operation an alarm signal is generated if the number of sheets counted is more than or less than a predetermined reference number of sheets, for instance, 100 sheets (hereinafter referred to as "an alarm mode").

The former machine is used for dividing a stack or bundle of many sheets into a plurality of stacks each consisting of a predetermined number of sheets (for instance 100 sheets). The latter machine is used for confirming the number of sheets which are bundled so that the bundle includes a predetermined number of sheets, for instance 100 sheets, (hereinafter referred to as "an official number of sheets"). Thus, the conventional sheet counting machine is operated only in the automatic stop mode or only in the alarm mode.

Accordingly, there is a strong demand for the provision of a sheet counting machine which can count a number of sheets in the alarm mode and also in the automatic stop mode, in order to improve efficiency in counting a number of sheets.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to provide a novel sheet counting machine which can be operated in both the automatic stop mode and the alarm mode described above.

Another object of the invention is to provide a sheet counting machine having a simple construction.

A further object of the invention is to provide a sheet counting machine which positively carries out a sheet counting operation.

The foregoing objects and other objects as well as the characteristic features of this invention will become more apparent from the following detailed description and the appended claim when read in conjunction with accompanying drawings, in which like parts are designated by like reference numerals or characters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a perspective view illustrating a sheet counting mechanism of a sheet counting machine to which this invention can be applied;

FIG. 2 is an explanatory diagram used for a description of a sheet counting operation carried out by the sheet counting machine;

FIG. 3 is a block diagram of an example of the sheet counting machine according to the invention;

FIG. 4 is a schematic diagram showing a control board of the sheet counting machine;

FIGS. 5 through 8 are circuit diagrams for the block diagram of FIG. 3; and

FIG. 9 is a perspective view showing the appearance of the sheet counting machine according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

As conducive to a full understanding of this invention, the construction of a sheet counting machine to which the invention can be applied will be described with reference to FIG. 1.

The sheet counting machine has a machine frame 1, a sheet laying plate 2 having an arc-shaped end which is rotatably mounted on a shaft 3, a pin 5 provided on the frame 1, and a sheet holding pin 4 embedded in the sheet laying plate 2. These pins 4 and 5 are connected with a spring 6 wound around the shaft 3 so that the plate 2 is turned counterclockwise as viewed from above.

The frame 1 is provided with a sheet sliding plate 8 in such a manner that there is a slight gap 7 between the plate 8 and the arc-shaped end edge of the plate 2, and the upper surface of the plate 8 is flush with that of the plate 2. The outer edge of the sheet sliding plate 8 is fixedly connected to a sheet stop 9 which forms a vertical wall. The left portion of the stop 9 has a slot 10. As is apparent from the above description and FIG. 1, the edge of the sheet sliding plate 8 is arc-shaped, and the wall of the stop 9 is cylindrical.

On the left side of the sheet sliding plate 8, there is a stop 11 rotatably mounted on a shaft 12. This stop is turned clockwise by a spring 13 so as to detain the rotation of the sheet sliding plate 8. Reference numeral 109 designates a part which engages an end of the spring 13. On the upper portion of the stop a release lever 14 is fixedly provided. The end portion of the release lever 14 is bent, and this bent portion extends inward through the slot 10 of the sheet stop 9 so that the right end portion 15 of the stop 11 engages with the left upper end portion 16 of the sheet laying plate 2 so as to detain the counterclockwise turning of the sheet laying plate 2 unless the release lever 14 is pressed outward by sheets.

The machine further comprises a sheet clamping holder 17 under which there is a sheet clamping holder operating member 18 rotatably mounted on the shaft 3. To one end portion of the member 18 one end portion (the lower end portion) of a U-shaped arm 19 is fixedly connected; while the other end portion 20 (the upper end portion) of the arm 19 is fixedly connected to the sheet clamping holder 17. A pin 21 is embedded in the holder operating member 18, and is coupled by a lever 22 having a slot 24 therein to a rotary disk 23b mounted on the rotary shaft 23a of an electric motor M₁ (not shown) through an eccentric shaft 23c provided on the rotary disk 23b. The lever 22 is coupled to the pin 21 through the slot 24. The pin 21 is pulled by a spring 25 toward the outer end of the slot 24. Thus, the lever 22 carries out a crank operation, that is, the lever 22 turns the member 18 and accordingly the holder 17 clockwise or counterclockwise according to rotation of the rotary disk 23b.

On the shaft 3 an arm member 31 is rotatably mounted which has a holder detaining pin 30 embedded in one end portion thereof. The spring 25 imparts a torque to the arm member 31 so that the arm member 31 is turned counterclockwise as viewed from above. Reference numeral 107 designates a part to which engages one end of the spring 25. The holder detaining rod 30 is so arranged that it protrudes through a recess

33 provided in the frame 1 so as to regulate the clockwise turning of the holder 17. The arm member 31 has a protruding portion 34 on the other end portion thereof. This protruding portion 34 engages with an adjusting screw 35 so as to regulate the counterclockwise turning of the arm member 31.

Thus, the spring 25 imparts a force to the holder operating member 18 and the arm member 31 so that these elements 18 and 31 approach each other.

Reference numeral 39 designates a spring which operates to turn the holder operating member 18 together with the arm member 31 clockwise.

The stop 11 has a lever 11a at its rear end portion with which insertion detecting switch M_5 is engaged.

Reference numeral 38 designates suction heads provided on a rotor 37 of the sheet counting mechanism. When the rotor 37 is revolved by a motor M_2 (not shown), these suction heads 38 rotate at a speed corresponding to the revolution of the rotor 37. The sheet counting mechanism thus organized is subjected to drive control by a drive control circuit as follows.

If a stack of sheets is laid on the sheet laying plate 2 in such a manner that the sheets stand against the holder 17, and is then moved toward the sheet stop 9, the stack of sheets will abut the stop thereby pressing the release lever 14 outward. By this operation, the stop 11 is turned around the shaft 12 counterclockwise, and the right lower corner 15 of the stop 11 is disengaged from the sheet laying plate 2. Accordingly, the sheet laying plate 2 is turned counterclockwise by the spring 6, as a result of which the stack of sheets is sandwiched between the holder 17 and the sheet holding pin 4 embedded in the sheet laying plate 2.

In the case of the automatic stop mode, when the stop 11 is turned counterclockwise, the switch MC_5 is turned on by the lever 11a and the motor M_1 is operated. By the operation of the motor M_1 , the lever coupled to the motor M_1 pushes the holder operating member 18, and accordingly the arm member 19 connected to the end portion of the holder operating member 18 turns the holder 17 clockwise. By this movement of the holder 17 the stack of sheets abut against the holder detaining pin 30, and therefore a further movement of the holder 17 is stopped. Under this condition, the end portion of the top sheet of the sheet stack comes to abut against a suction head 38 on the rotor 37. On the other hand, a vacuum pump VPM (now shown) is operated by the operation of the switch MC_5 . When a vacuum created by the vacuum pump VPM reaches a predetermined value, a vacuum switch is actuated so that the suction heads 38 and the rotor 37 are rotated. As a result, the sheets in a stack are bent back around pin 30 one by one by the suction heads 38 to count the number of sheets as is shown in FIG. 2.

In order to clamp the stack of sheets with the holder 17 and the pin 30, the motor M_1 is rotated in the same direction again to produce the crank operation of the lever 22 and thereby to turn the holder 17 counterclockwise.

The sheet counting machine according to this invention employs a drive control circuit for the above-described sheet counting mechanism as shown in FIG. 3.

The drive control circuit has a main control section 55 which delivers drive condition signals to a holder motor driving circuit 50, a rotor driving motor driving circuit 51, a vacuum pump driving circuit 52, a sheet separating solenoid driving circuit 53, and a winker

circuit 54. The main control section 55 receives, as its input condition signals, a count confirmation signal a from a count confirmation circuit 56, a detection signal b from the vacuum switch VS, a detection signal c from a holder position detector HP, and a detection signal d from the detector MC_5 , operating to detect the insertion of a stack of sheets.

The main control section 55, as is shown in FIG. 4, comprises a mode changing switch PB_3 , a manual start switch PB_2 , an automatic start switch PB_5 , a reset switch PB_4 , and a power switch PB_1 , the key levers of which are arranged on a control board 58.

A first normally-open contact means PB_{11} of the power switch PB_1 , as is shown in FIG. 5, is connected between one power terminal U and a power line l_1 . The other power terminal V is connected directly to a power line l_1 . The other power terminal V is connected directly to a power line l_2 .

The mode changing switch PB_3 is composed by three stay-down key switches operatively associated with one another, that is, the switch PB_3 is composed by an automatic stop mode selecting switch PB_{3A} , an alarm mode selecting switch PB_{3B} , and a count mode selecting switch PB_{3C} . The automatic start switch PB_5 is also a stay-down key switch.

The term "count mode" herein used means a sheet counting operation in which all of the sheets inserted in the sheet counting mechanism are completely counted, and upon completion of the counting operation the operation of the sheet counting mechanism is suspended.

In the example described above, as is shown in FIG. 5 one contact of a selecting switch PB_{3A1} , two contacts of a selecting switch PB_{3B1} and three contacts of a selecting switch PB_{3C1} are cascade-connected in the order stated. This cascade connection circuit forms a conduction path only when any one of the switches PB_{3A1} , PB_{3B1} and PB_{3C1} is operated. The cascade connection circuit is a part of a start circuit 60 of the main control section 58.

The start circuit 60 has a relay RL_1 . When a manual start switch PB_{21} is depressed upon operation of manual start switch PB_2 , the relay RL_1 is energized by forming a loop: the power line l_2 — a normally closed contact means of a count confirmation relay RL_5 described later — the relay RL_1 — the selection switches PB_{3A1} , PB_{3B1} , PB_{3C1} — a contact means PB_{21} of the manual start switch PB_2 — a normally closed contact means RL_{51} of the count confirmation relay RL_5 — a normally closed contact means RL_{41} of the count operation relay RL_4 — the power line l_1 . On the other hand, when a stack of sheets is inserted into the holder 17 with the automatic start switch PB_{51} turned on, the relay RL_1 is energized through a loop: the power line l_2 — the normally closed contact means of the count confirmation relay RL_5 — the relay RL_1 — the selection switches PB_{3A1} , PB_{3B1} , PB_{3C1} — a sheet insertion detecting switch MC_{51} — a contact means PB_{51} of the automatic start switch PB_5 — the power line l_1 . This energization is self-maintained because the armature of a contact means RL_{12} of the relay RL_1 is thrown to the normally open contact NO thereof by the energization of the relay RL_1 .

An output line d_1 is connected between the normally closed contact NC of the contact means RL_{12} of the relay RL_1 and the holder motor driving circuit 50. Furthermore, an output line d_2 is extended from the normally open contact NO of a contact means RL_{41} of a

5

relay RL_4 to the vacuum pump driving circuit 52 and the rotor driving motor driving circuit 51.

The holder motor driving circuit 50 has a holder open position detecting switch MC_{11} the armature of which is thrown to the normally open contact from the normally closed contact when the holder 17 reaches the open position, and a holder closure position detecting switch MC_{21} the armature of which is thrown to the normally closed contact from the normally open contact when the holder 17 reaches the closure position.

The holder motor M_1 is energized through a loop: the power line l_2 — the normally open contact of a contact means PB_{12} of the power switch PB_1 — the normally closed contact of the holder open position detecting switch MC_{11} — the normally open contact of the holder closure position detecting switch MC_{21} .

The detecting switches MC_{11} and MC_{21} , as is shown in FIG. 2, are arranged to confront cam disks K_1 and K_2 coupled to the output shaft 23a of the holder motor M_1 , respectively, so that the armature of the switch MC_{11} is maintained connected to the normally closed contact, but is thrown to the normally open contact only when the holder 17 reaches the open position to cause a projection of the cam disk K_1 to actuate the switch MC_{11} , and so that the armature of the switch MC_{21} is maintained connected to the normally open contact, but is thrown to the normally closed contact only when the holder 17 reaches the closure position to cause a recess of the cam disk K_2 to actuate the switch MC_{21} .

Accordingly, the motor M_1 is driven through the above-described loop until the holder 17 has reached the open position (or the closure position, and thereafter the motor M_1 is stopped when the switch MC_{11} (or MC_{21}) is operated to open the loop. This stop-condition of the motor is maintained until the projection (or the recess) of the cam disk K_1 (or K_2) is disengaged from the switch MC_{11} (or MC_{21}) by driving the motor M_1 again whereby the loop is formed again.

The output line d_1 of the start circuit 60 is connected between the switches MC_{11} and MC_{21} in order to open the holder 17, and a normally open contact means RL_{11} of the relay RL_1 of the start circuit 60 is connected in parallel to the switch MC_{11} in order to close the holder 17.

It is assumed that, with respect to the holder motor driving circuit 50, the holder 17 is at the closure position as is shown in FIG. 2, whereby the armatures of the switches MC_{11} and MC_{21} are on the normally closed contacts NC and the machine is stopped.

Under this condition, if the armature of the power switch PB_{12} is thrown to the normally open contact NO, the power switch PB_{12} will be connected to the output line d_1 of the start circuit 60 through the normally closed contact of the switch MC_{11} , that is, the output line d_1 will be connected to the power line 1_1 through a loop: the contact means RL_{12} of the relay RL_1 — the contact means RL_{51} of the relay RL_5 — the contact means RL_{41} of the relay RL_4 . As a result, the motor M_1 is driven, and soon thereafter the switch MC_{21} is disengaged from the recess of the cam disk K_2 , that is, the armature of the switch MC_{21} is thrown to the normally open contact NO, whereby a loop of the switch MC_{11} — the switch MC_{21} is formed, so that the operation of the motor M_1 is continued. Thus, the holder 17 continues to move from the closure position until the holder 17 reaches the open position to throw the armature of the switch MC_{11} to the contact NO.

6

If, when the holder 17 is at the open position, the relay RL_1 of the start circuit 60 is energized, the contact means RL_{11} is closed and the switch MC_{11} is bypassed, whereby the motor is driven. Soon, the projection of the cam disk K_1 is disengaged from the switch MC_{11} whereby the loop of the switch MC_{11} — the switch MC_{21} is formed again. Through the loop thus formed the motor is driven. Thus, the holder 17 continues to move from the open position until the holder 17 reaches the closure position to throw the armature of the switch MC_{21} to the contact NC.

If, when the holder is at the closure position, the relay RL_1 is deenergized to throw the armature of the contact means RL_{12} to the contact NC, the holder 17 carries out its opening operation as described above.

In the example, a second holder position detecting switch MC_{22} is connected in parallel to the power switch PB_{11} . If, when the holder 17 is at a position other than the closure position, the power switch PB_{11} is opened, the motor M_1 is energized through the switch MC_{22} until it is opened. Thus, when the operation of the sheet counting mechanism is suspended, the holder 17 is always returned to the closure position.

The vacuum pump driving circuit 52 comprises a vacuum switch VS provided at the output side of the vacuum pump VPM and which acts as a completion detecting means for detecting when counting is completed. When the vacuum produced by the vacuum pump VPM is sufficient for sucking sheets, the armature of the switch VS is thrown to the normally open contact NO so that the count operation relay RL_4 is energized through the normally closed contact means RL_{53} of a relay RL_5 . As a result, the armature of the contact means RL_{41} in the start circuit is thrown to the normally open contact NO, and a vacuum pump driving relay RL_3 connected to the output line d_2 of the start circuit 60 is energized. Furthermore, the relay RL_3 is energized through an output line d_3 connected to the normally closed contact NC of the switch MC_{21} in the holder motor driving circuit 50 and through a normally open contact means RL_{13} of the relay RL_1 in the start circuit 60. When the relay RL_3 is energized, the a normally open contact means RL_{32} of the relay RL_3 is closed and vacuum pump VPM is driven.

If, when the holder 17 is at the closure position, the armature of the switch MC_{21} of the circuit 50 is thrown to the normally closed contact, the relay RL_3 is energized through the contact means RL_{13} of the RL_1 and the vacuum pump VPM is driven. When the vacuum of the vacuum pump VPM is increased and the armature of the vacuum switch VS is thrown to the normally open contact NO, the relay RL_4 is energized. As a result, the armature of the contact means RL_{41} is thrown to the normally open contact NO to energize the relay RL_3 . At the same time, the self-maintaining of the relay RL_1 in the start circuit 60 is released to open the contact means RL_{12} .

The rotor driving motor driving circuit 51, similar to the vacuum pump driving relay RL_3 , is connected to the output line d_2 of the start circuit 60, and to the output line d_3 of the holder motor driving circuit 50 through the contact means RL_{13} of the relay RL_1 , and has a series circuit of a normally open contact means RL_{31} of the relay RL_3 and a normally closed contact means RL_{15} of the relay RL_1 . Accordingly, the rotor driving motor M_2 is operated by the energization of the relay RL_3 .

An output line d_4 connected to the normally open contact NO of the switch MC_{11} in the holder motor driving circuit 50 is connected to a reverse rotation terminal of the rotor driving motor M_2 through a predetermined position detecting switch MC_3 provided in association with the output shaft of the motor M_2 . Therefore, when the holder 17 reaches the open position and the armature of the switch MC_{11} is thrown to the normally open contact, the motor M_2 is rotated in the opposite direction until the switch MC_3 is opened, whereby the motor M_2 is stopped at the predetermined position.

The normally closed contact of the vacuum switch VS is connected to a pressure releasing solenoid valve SV provided in the vicinity of a suction port of the suction heads 38 so that, when the switch VS has detected reduction of the vacuum and the armature of the switch VS has been therefore thrown to the normally closed contact, the valve SV is abruptly opened so that sheets are no longer drawn to the suction heads.

In the sheet counting machine according to this invention, the count confirmation output a of the count confirmation circuit 56 is applied, as a control input, to the drive control circuit described above.

The count confirmation circuit 56, as is shown in FIG. 3, comprises a counter 66 of, for instance, three digits which counts output pulses of a sheet count detector 65. Data of the counter 66 are displayed on a displayer 67 provided on the control board 58 (FIG. 4) and are produced as binary-coded decimal outputs.

The sheet count detector 65, as is shown in FIG. 2, comprises a proximity switch 69 provided adjacent the peripheral surface of the rotor 37. Iron pieces 68 are provided on the peripheral surface of the rotor 37 in correspondence to the positions of the suction heads 38 so that the iron pieces pass across the proximity switch 69 during the rotation of the rotor 37. Accordingly, whenever one iron piece 68 passes across the proximity switch 69, one count pulse is produced by the proximity switch 69.

The count pulses thus obtained are introduced to the counter circuit 66 through an input gate circuit 70 which opens when the relay RL_4 (FIG. 5) is energized. The digit outputs of the counter 66 are applied, as count inputs, to a coincidence detecting circuit 71.

The counter 66 is reset by a normally open contact means RL_{16} of the start RL_1 when the start relay RL_1 is energized for starting the succeeding count operation. In addition, the counter 66 is also reset by a normally closed contact means RL_{61} of a reset relay RL_6 (FIG. 6) when the reset switch PB_4 is depressed.

The count confirmation circuit 56 has a device 72 which is adapted to manually set a number of sheets to be counted and to produce a binary-coded decimal output for each of the three-digit number of sheets (hereinafter referred to as "a manual number setting device 72"). These binary-coded decimal outputs are applied, as set inputs, to the coincidence detecting circuit 71.

The coincidence detecting circuit 71 operates to compare the digit outputs of the counter 66 with the digit outputs, in the form of the binary-coded decimal outputs, of the manual number setting device 72, respectively, and upon coincidence, produce a coincidence output at a low voltage level (hereinafter referred to as a logical L level when applicable) for every digit. This coincidence output is applied to a confirmation signal producing circuit 73.

The confirmation signal producing circuit 73, as is shown in FIG. 7, has a diode AND circuit 80 with inverters I. Through the inverters I, the AND circuit 80 receives the coincidence outputs CO_1 , CO_2 , and CO_3 produced by the coincidence detecting circuit 71 for the respective digits of the number of sheets to be counted, respectively. An output of the diode AND circuit 80 is applied to an output condition circuit 82 through an amplifier circuit 81 composed by cascade-connecting three npn-type transistors Q_1 , Q_2 and Q_3 .

In the amplifier circuit 81, the base of the transistor Q_2 is connected to a low level bus line BL through a normally open contact means RL_{103} of an alarm mode relay RL_{10} shown in FIG. 8, and an output of the diode AND circuit 80 is applied to the base of the transistor Q_3 through an inverter IN_1 and a normally open contact means RL_{104} of the relay RL_{10} .

In the output condition circuit 82, there are connected in series a switching transistor W controlled by the output of the amplifier circuit 81, an output relay RL_7 , a normally open contact means RL_{82} of an output condition relay RL_8 in a confirmation output condition circuit 83 (FIG. 5) of the main control section 55, a normally closed contact means RL_{46} of the count operation relay RL_4 , and a normally open contact of a contact means RL_{105} of the alarm mode relay RL_{10} ; and the connection point of the contact means RL_{82} and RL_{46} is connected to the normally closed contact of the contact means RL_{105} .

The confirmation output condition relay RL_8 is energized through a series circuit of a contact means R_{45} of the relay RL_4 , a normally closed contact means RL_{18} of the start relay RL_1 , and a normally closed contact means RL_{62} of the reset relay RL_6 when the vacuum of the vacuum pump VPM reaches the predetermined value and the relay RL_4 is energized, as a result of which the contact means RL_{82} (FIG. 7) is closed. The energized condition of the relay RL_8 is self-maintained through the normally open contact means RL_{81} , but is released by opening the contact means RL_{81} when the reset operation is effected or when the relay RL_1 is energized.

The alarm mode relay RL_{10} (FIG. 8) is energized when an alarm mode switch PB_{3B2} is closed, as a result of which the armature of the contact means RL_{103} is thrown to the normally open contact from the normally closed contact.

The operation of the count confirmation circuit 56 will now be described.

When the alarm mode has been selected, that is, the alarm mode switch PB_{3B2} (FIG. 8) has been closed, the contact means RL_{103} and RL_{104} of the relay RL_{10} are closed, i.e. thrown to the NO contact thereof, while the armature of the contact means RL_{105} is switched over to the normally open contact (FIG. 7). Accordingly, the transistor Q_2 in the amplifier circuit 81 is in the off-state, and the collector level output at a high level of the transistor Q_2 is applied to the base of the transistor Q_3 .

Under this condition, at least one of the digit outputs of the coincidence detecting circuit 71 is at a high level during a period when the count data of the counter 66 does not coincide with the set data of the manual number setting device 72. Therefore, the output (at a low level) of the diode AND circuit 80 is applied, as a high level input, to the transistor Q_3 through the inverter IN_1 . Accordingly, the transistor Q_3 is caused to be on and its collector level is at a high level which maintains

the switching transistor W of the output condition circuit 82 conductive. If in this case the sheet counting mechanism is operating, the count operation relay RL₄ is in an energized state and its contact means RL₄₆ is open. Accordingly, the output relay RL₇ is in a non-energized state.

If the sheet counting mechanism completes the counting of all of the sheets in a stack and the count operation relay RL₄ is therefore deenergized (with the armature of the vacuum switch VS being thrown to the normally closed contact) although no coincidence is detected by the coincidence detecting mechanism yet, the contact means RL₄₆ is closed, as a result of which the output relay RL₇ is energized. This will be referred to as a first case.

In a second case where the sheet counting operation is completed as soon as the coincidence is detected by the coincidence detecting circuit 71, all of the digit outputs become low in level. As a result, the output of the inverter IN₁ becomes low in level, and the transistor Q₃ is therefore turned off. Accordingly, the transistor W of the output condition circuit 82 is also made non-conductive, and the output relay RL₇ is not energized.

In a third case where the sheet counting operation is still continued although the coincidence has been detected by the coincidence detecting circuit 71, when the first detection pulse occurring after the coincidence arrives at the counter 66, all of the digit outputs of the coincidence detecting circuit 71 become high in level (since the counter 66 is overflowed and all the digits have the FIG. 9), as a result of which the relay RL₇ is energized upon completion of the sheet counting operation similarly as in the first case described above.

In the case where the alarm mode switch PB_{3B2} (FIG. 8) is open (not depressed), the contact means RL₁₀₃ and RL₁₀₄ of the relay RL₁₀ are open, and the armature of the contact means RL₁₀₅ is on the normally closed contact NO.

When the coincidence has not yet been detected by the coincidence detecting circuit 71, the output of the diode AND circuit 80 is at a low level, and therefore the transistors Q₁, Q₂ and Q₃ are off, on, and off, respectively. Therefore, the switching transistor W of the output condition circuit 82 is non-conductive, and the relay RL₇ is therefore maintained in a deenergized state. This will be referred to as a first condition.

When after the first condition the coincidence is detected by the coincidence detecting circuit 71, the output of the diode AND circuit 80 becomes high in level, and therefore the switching transistor W is made conductive, and therefore the relay RL₇ becomes energized. This will be referred to as a second condition.

When after the second condition the sheet counting operation is further continued by the sheet counting mechanism and the coincidence is not detected by the coincidence detecting circuit 71 because of the overflow of the counter 66, the first condition described above occurs again and the relay RL₇ is deenergized.

When the relay RL₇ is energized, its output actuates a contact means in a stop condition circuit 90 of the main control circuit 55. The stop condition circuit 90 includes the count confirmation relay RL₅ which is energized through a normally open contact means RL₇₁ of the relay RL₇ and a normally closed contact means PB_{3A2} of the count switch PB_{3A}. Upon energization of the relay RL₅, the contact means RL₅₁ connected to the output line d₁ of the start circuit 60 is opened.

The count switch PB_{3A2} of the stop condition circuit 90 is also used in common for driving the winker circuit 54 and the sheet separating solenoid driving circuit 53. More specifically, the winker circuit 54 and the solenoid driving circuit 53 are connected between the power lines l₁ and l₂ through the count switch PB_{3A2} and a cascade connected circuit of an alarm switch PB_{3B3} and an automatic stop switch PB_{3C2} consisting of two contact means. The winker circuit 54 becomes operative by depressing the alarm switch PB_{3B3} only, while the solenoid driving circuit 53 becomes operative by depressing the automatic stop switch PB_{3C2} only. The cascade-connected circuit is a protection circuit which, when the two switches PB_{3B3} and PB_{3C2} are depressed by mistake, prevents the circuits 54 and 53 from becoming operative.

The winker circuit 54 is provided with a contact means RL₅₂ of the count confirmation relay RL₅. If, when the alarm switch PB_{3B3} has been depressed, the relay RL₅ is not energized, the armature of the contact means RL₅₂ is on the normally closed contact NC, whereby an alarm mode selection display lamp 93 is continuously operated. If the relay RL₅ is energized, the armature of the contact means RL₅₂ is thrown to the normally open contact NO, whereby the lamp 93 starts its winking operation.

The solenoid driving circuit 53 is provided with a normally open contact means RL₇₂ of the relay RL₇ in the output condition circuit 82 (FIG. 7). If, when the automatic stop switch PB_{3C2} has been depressed, the relay RL₇ is energized, a solenoid 94 connected to the solenoid driving circuit 53 is energized, and as is shown in FIG. 2, a sheet separating pawl 96 is operated to separate a stack of sheets 95 from the suction head 38.

Reference character Z indicated in FIGS. 5, 6 and 7 designates arc-suppression circuits connected in parallel to the respective contact means.

In FIGS. 4 and 5, reference numeral 98 designates an automatic start condition selection display lamp which is turned on when a normally open contact means PB₅₂ of the automatic start switch PB₅ is closed.

When the sheet counting machine thus organized is not operated, the holder 17 (FIGS. 1 and 2) is at the closed position.

In this condition, first operator determines whether or not the machine should be automatically started by using the automatic start switch PB₅, and selects one count mode by selectively depressing one of the switches in the mode changing switch PB₃.

When the automatic stop mode selecting switch PB_{3C} has been depressed by the operator, he sets a number of sheets to be counted in the automatic stop mode in the manual number setting device 72. When the alarm mode selection switch PB_{3B} has been depressed by the operator, he sets in the manual number setting device 72 a number of sheets which should be included in a stack (for instance 100, where an official bundle of 1,000-yen bank notes has 100 sheets of 1,000-yen notes). When the count mode selecting switch PB_{3A} has been depressed by the operator, he sets 0 for all the digits in the manual number setting device 72. Thereafter, he turns on the power switch PB₁.

By turning on the power switch PB₁, the holder motor M₁ is driven through the loop made up of the contact means PB₁₂ of the power switch PB₁, the open position detecting switch MC₁₁, the output line d₁, the contact means RL₁₂ of the relay RL₁, the contact means RL₅₁ of the relay RL₅, and the contact means RL₄₁ of the relay

RL₄. As a result, the holder 17 is moved to the open position. Now the operator can insert a stack of sheets 95 into the holder 17.

In the case where the automatic start switch PB₅ has been depressed, the start relay RL₁ is energized immediately when the sheet insertion detecting switch MC₅₁ is closed. In the case where the automatic start switch PB₅ has not been depressed by the operator, he depresses the manual start switch PB₂ to close the contact means Pb₂₁, as a result of which the relay RL₁ is energized.

While the start relay RL₁ is self-maintained through its contact means RL₁₂, the motor M₁ is driven again through the loop made up of the power switch PB₁₂, the contact means RL₁₁ of the relay RL₁, and the closure position detecting switch MC₂₁. As a result, the holder 17 is closed to hold the stack of sheets 95 between the holder 17 and the pin 30, that is, the stack of sheets 95 abuts against the suction head 38.

When the holder 17 is moved to the closed position, the vacuum pump relay RL₃ is energized through the loop made up of the detecting switch MC₂₁, the output line d₃ and the contact means RL₁₃ of the relay RL₁, as a result of which the vacuum pump VPM is operated and the rotor driving motor M₂ starts.

When the output vacuum of the vacuum pump VPM has reached the predetermined value, the vacuum switch VS is operated to energize the count operation relay RL₄. Accordingly, the operations of the vacuum pump VPM and the rotor driving motor M₂ are continued. On the other hand, the air releasing solenoid valve Sv is closed by the operation of the vacuum switch VS, as a result of which the predetermined vacuum is applied to the suction heads 38 to count the number of sheets in the stack 95.

Furthermore, the energization of the relay RL₄ causes the input gate 70 of the count confirmation circuit 56 (FIG. 3) to open. Through the gate 70 thus opened, count pulses of the detector 65 are applied to the counter 66, which operates to display a numerical value corresponding to the sheet counting operation of the suction heads 38 on the displayer 67.

The response operations of the sheet counting machine in completing the sheet counting operation differ according to the sheet counting modes as follows.

First, the case where the automatic stop mode has been selected will be described. In the output circuit 73 of the count confirmation circuit 56, the contact means RL₁₀₃ and RL₁₀₄ of the alarm mode relay RL₁₀ are open, and the armature of the contact means RL₁₀₅ is on the normally closed contact NC. Accordingly, when the contents of the counter 66 coincide with the numerical value set in the manual number setting device 12, the switching transistor W of the output condition circuit 82 is made conductive. On the other hand, the confirmation output condition relay RL₈ (FIG. 5) is self-maintained in the energized condition. Therefore, the output relay RL₇ is energized immediately upon the transistor W becoming conductive.

As a result, the sheet separating solenoid 94 is energized through the contact means RL₇₂ provided in the solenoid driving circuit 53, and the sheet separating pawl 96 (FIG. 2) separates the stack of sheets 95 from the suction head 38. Accordingly, the suction head 38 sucks the air, pressure vacuum pressure therein is abruptly lowered, and the vacuum switch VS becomes inoperative, thereby detecting the completion of counting of sheets. Therefore, the armature of the switch VS

is thrown to the normally closed contact NC, the relay RL₄ is deenergized, and the armature of the contact means RL₄₁ in the start circuit 60 is thrown to the normally closed contact. As a result, the operations of the vacuum pump VPM and the rotor driving motor M₂ are suspended. On the other hand, the count confirmation relay RL₅ in the circuit 90 is energized by the energization of the relay RL₇. Thus, the sheet counting operation is completed with the holder 17 kept at the closed position.

In the case when all of the sheets in the stack 95 have been counted before the content of the counter 66 coincides with the numerical data set in the manual number setting device 72, the relay RL₇ is not energized, and therefore the sheet separating pawl 96 is not operated. However, since there is no sheet on the suction head 38 in this case, the suction head 38 sucks air instead of sheets, as a result of which the vacuum therein is abruptly lowered. Accordingly, the relay RL₄ is deenergized. On the other hand, the count confirmation relay RL₅ is in the deenergized state since the contact means RL₇₁ is open. Therefore, the output line d₁ of the start circuit 60 is connected to the power line l₁ through the loop made up of the contact means RL₁₂ of the relay RL₁, the contact means RL₅₁ of the relay RL₅, and the contact means RL₄₁ of the relay RL₄, so that the holder motor M₁ is driven through the open position detecting switch MC₁₁. As a result, the sheet counting operation is ended with the holder 17 kept at the open position.

Second, the case where the alarm mode has been selected will be described. In this case, the contact means RL₁₀₃ and RL₁₀₄ of the alarm mode relay RL₁₀ are closed while the armature of the contact means RL₁₀₅ thereof is on the normally open contact NO in the circuit 73 of the count confirmation circuit 56. Therefore, the switching transistor W is rendered non-conductive when the contents of the counter 66 coincide with the numerical data set in the manual number setting device 72, but is rendered conductive when the contents of the counter 66 do not coincide with the numerical data set in the device 72.

During the period the suction heads 38 are counting the sheets 95, the relay RL₄ is kept energized to keep the contact means RL₄₆ (FIG. 7) open, and therefore the relay RL₇ is not energized.

When the suction heads 38 have counted all of the sheets, there is no sheet on the suction head 38. Accordingly, the vacuum in the suction head 38 is lowered and the relay RL₄ is deenergized. As a result, similar to the case described above, the operations of the vacuum pump VPM and the rotor driving motor M₂ are suspended. Upon deenergization of the relay RL₄, the contact means RL₄₆ is closed, and therefore the output relay RL₇ is energized when the transistor W is conductive (that is, the number of sheets counted is more or less than the set value). Under this condition, the count confirmation relay RL₅ in the circuit 90 is energized and the armature of the contact means RL₅₂ in the winker circuit 54 is thrown to the normally open contact, as a result of which the display lamp 93 starts its winking operation. On the other hand, since the contact means RL₅₁ of the start circuit 60 is opened by the energization of the relay RL₅, the output line d₁ is not connected to the power line l₁. As a result, the sheet counting operation is ended with the holder 17 kept at the closed position.

On the other hand, when the transistor W is non-conductive (that is, the number of sheets counted is equal to the set value), the output relay RL₇ is not energized and therefore the display lamp 93 of the winker circuit 54 does not carry out the winking operation. In addition, the contact means RL₅₁ in the start circuit 60 is closed to connect the output line d₁ to the power line l₁. As a result, the sheet counting operation is ended with the holder 17 kept at the open position.

In the case where the sheet counting operation in the alarm mode is repeatedly carried out with respect to a plurality of stacks of sheets, the contents of the counter 66 sometimes coincide with the contents set in the manual number setting device 72 during the period time of from the time instant when the start relay RL₁ of the start circuit 60 is energized to the time instant when the previous count contents of the counter 66 is reset. In this case, the winker circuit 54 is sometimes operated. In order to prevent this, the normally open contact means RL₈₂ of the confirmation output condition relay RL₈ is provided in the confirmation signal producing circuit 73.

Thirdly, in the case where the count mode has been selected, the count mode selecting switch PB₃₄₂ of the stop condition circuit 90 is open, and therefore the winker circuit and the automatic stop solenoid driving circuit are not operated. When all of the sheets have been counted, no sheet abuts the suction head, that is, the suction head 38 is opened to the atmosphere. Accordingly, the operations of the vacuum pump VPM and the rotor driving motor M₂ are suspended. On the other hand, when the relay RL₄ is deenergized, the contact means RL₅₁ in the start circuit 60 is closed to connect the output line d₁ to the power line l₁, as a result of which the holder motor M₁ is driven. Thus, the sheet counting operation is completed with the holder 17 kept at the open position.

As is apparent from the above description, according to the invention, in the automatic stop mode the sheet counting operation is automatically suspended with the holder 17 closed when the number of sheets counted coincides with a number of sheets set; and in the alarm mode the winker circuit 54 is operated while the holder 17 is maintained closed when the number of sheets counted does not coincide with a number of sheets set upon completion of the sheet counting operation; and in the count mode all of the sheets are counted without operation of the alarm. Thus, the sheet counting machine according to this invention can positively carry out the sheet counting operation in all of the sheet counting modes.

Furthermore, in the automatic stop mode and also in the alarm mode, the count confirmation output a used in common for both of the modes is obtained on the basis of the output of the sheet number setting device operated to set a number of sheets to be counted and the output of the counter. As a result, the sheet counting machine according to the invention is simple in construction and able to positively carry out the sheet

separating operation and the count confirming operation with respect to a number of sheets set as desired.

What is claimed is:

1. In a sheet counting machine having a counting means for counting a number of sheets being separated one by one from a stack of sheets held in a sheet holder; a number setting means for setting in advance a number of sheets desired to be counted; a coincidence detecting means to which said counting means and said number setting means are coupled for producing, when a count value obtained by said counting means coincides with the numerical value set in said number setting means, a coincidence detection signal; a completion detecting means for detecting, when the operation of counting all of the sheets in a stack held by said holder has been completed, the completion of said counting operation and producing a completion detection signal; and a control means to which said coincidence detecting means and said completion detecting means are coupled for controlling a sheet counting operation in cooperation with said counting means, said control means:

a. automatic stop mode means for controlling the machine in an automatic stop mode and responsive to the coincidence detection signal produced by said coincidence detecting means for stopping the sheet counting operation of said machine when the count value obtained by said counting means coincides with the numerical value set in said number setting means;

b. alarm mode means for controlling the machine in an alarm mode and including alarm means and means responsive to the coincidence detection signal produced by said coincidence detecting means for inhibiting the stopping of a sheet counting operation through said control means and responsive to the completion detection signal produced by said completion detection means for stopping the sheet counting operation when an operation of counting all of the sheets in a stack held in said holder is completed, and if during this operation no coincidence detection signal is produced by said coincidence detecting means operating said alarm means; and

c. count mode designating means for controlling the machine in a count mode and including means for inhibiting the sheet counting operations effected by operation of said automatic stop mode means and said alarm mode means, and means responsive to the completion detection signal produced by said completion detecting means for stopping, when the counting of all of the sheets in a stack held in said holder is completed, the sheet counting operation,

whereby sheets in a stack held in said holder are counted in a desired mode selected from among said automatic stop mode, alarm mode, and count mode by selective operation of said automatic stop mode means, alarm mode means and count mode designating means.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,983,367
DATED : September 28, 1976
INVENTOR(S) : TAKASHI KONDO et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, left-hand column add:

[30] Foreign application priority data

February 14, 1974 Japan 49-17126

Signed and Sealed this
Twenty-eighth **Day of** December 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks